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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/546,625
Filing Date: February 27, 2006
Appellant(s): HECKER ET AL.

Gerard A. Messina
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed November 9, 2009 appealing from the Office action mailed June 10, 2009.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6347269	Hayakawa et al.	02-2002
6167357	Zhu et al.	12-2000
6745112	Mori	06-2004

6567734	Bellinger et al.	05-2003
4773013	Crapanzano et al.	09-1988

Randal, V.T. et al. "Floating-Point Computation Using a Microcontroller" Proceedings of the Annual International Conference of the IEEE, 1988, pp. 1243-1244, vol. 3.

Predko, M. "Programming and Customizing the PIC Microcontroller" New York, NY: McGraw-Hill, 1998, pp. 302-304

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 13-17, 21, 22, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hayakawa et al. (US 6347269 B1) in view of Crapanzano et al. (US 4773013).

Regarding claim 13, Hayakawa teaches a method for effecting a computer-aided estimation of a mass of a vehicle, comprising: high pass filtering an equilibrium relationship, between a motive force and a sum of an inertial force and drive resistances, in which the mass and a gradient angle of a roadway are included as quantities, with respect to time, assuming a constant gradient angle; and calculating at least one of (a) the mass of the vehicle and (b) a reciprocal value of the mass of the

vehicle from the equilibrium relationship passed through a high pass filter (see Hayakawa Abstract; column 4, lines 42-49; column 5, lines 5-15; column 5, lines 36-45; figure 3 and column 5, line 46 thru column 6, line 23).

However, while Hayakawa teaches where the equilibrium relationship is passed through a high pass filter, it does not explicitly teach where the equilibrium relationship is computer differentiated with respect to time.

Crapanzano teaches an antiskid control system for a vehicle that uses a high pass filter to determine the derivative of the deceleration of the vehicle (see Crapanzano column 6, lines 62-68 and column 7, lines 1-5 where the wheel speed of an aircraft is passed through a first differentiator to determine the deceleration of an aircraft, i.e. the first derivative of the wheel speed, which is then passed through a second differentiator to determine the rate of change of deceleration, i.e. the second derivative of the wheel speed. Both differentiators are high pass filters. Although Crapanzano teaches where only the derivative of the deceleration is determined, the high pass filtering is equally applicable to determine the derivative of the acceleration or the force).

It would be obvious to one skilled in the art to use the high pass filter as taught in Hayakawa to differentiate the equilibrium relationship with respect to time because a high pass filter may be used to determine the derivative of a value and determining the derivative of a value is well known in the art as taught in Crapanzano (see Crapanzano column 6, lines 62-68 and column 7, lines 1-5).

Regarding claim 14, Hayakawa, as modified by Crapanzano in claim 13, teaches where the vehicle includes a commercial vehicle (see Hayakawa column 1, lines 18-33).

Regarding claim 15, Hayakawa, as modified by Crapanzano in claim 13, teaches where the drive resistances include a sum of one of (a) an accelerative force and (b) a deceleration force as a function of the mass and one of (a) an uphill force and (b) a downhill force as a function of the gradient angle (see the rejection of claim 13 above. See also Hayakawa column 7, lines 38-51 and column 4, lines 31-41).

Regarding claim 16, Hayakawa, as modified by Crapanzano in claim 13, teaches where the mass is calculated from the equation: $m = (dF / dt) / (da / dt)$ wherein a represents a time derivation of a longitudinal vehicle velocity and F represents the motive force of the vehicle (see Hayakawa column 6, lines 26-41 where the mass can be determined from equation (5) "$\underline{\alpha}(k) = \underline{F}(k)/(\theta m) + e(k)$" where $\underline{\alpha}$ is the acceleration deducted by a signal of lower frequency, $\underline{F}$ is the driving force deducted by a lower frequency, k is a sampling time interval, θm is the vehicle mass, and e(k) is the residual error due to the gradient. In instances where e(k) is negligible, it can be ignored and rearranging equation 5 will result in $\theta m = \underline{F}(k)/ \underline{\alpha}(k)$. See the rejection of claim 13 above regarding determining the derivative using a high pass filter).

Regarding claim 17, Hayakawa, as modified by Crapanzano in claim 13, teaches where the method further comprises: determining, from measured quantities, the motive force and the one of (a) the acceleration and (b) the deceleration (see Hayakawa figure 6, acceleration sensor 30, throttle valve sensor 12, engine rotation speed sensor 14, shift sensor 18, vehicle speed sensor 20. See also column 7, lines 18-58).

Regarding claim 21, Hayakawa, as modified by Crapanzano in claim 13, teaches where the computer-aided differentiating is performed continuously and recursively (see Hayakawa column 6, lines 26-60).

Regarding claim 22, Hayakawa, as modified by Crapanzano in claim 13, teaches where the computer-aided differentiating is performed one of (a) according to a two-point differentiation and (b) with a state-variable filter (see the rejection of claim 13 regarding differentiation).

Regarding claim 24, Hayakawa teaches a device for effecting a computer-aided estimation of a mass of a vehicle, comprising: a calculation unit adapted to calculate at least one of (a) the mass of the vehicle and (b) a reciprocal value of the mass of the vehicle from an equilibrium relationship between a motive force and a sum of an inertial force and drive resistances, the mass and a gradient angle of a roadway included as calculation quantities, after a computer-aided differentiation of the equilibrium relationship with respect to time, assuming a constant gradient angle (see Hayakawa Abstract; column 4, lines 42-49; column 5, lines 5-15; column 5, lines 36-45; figure 3 and column 5, line 46 thru column 6, line 12).

However, while Hayakawa teaches where the equilibrium relationship is passed through a high pass filter, it does not explicitly teach where the equilibrium relationship is computer differentiated with respect to time.

Crapanzano teaches an antiskid control system for a vehicle that uses a high pass filter to determine the derivative of the deceleration of the vehicle (see Crapanzano column 6, lines 62-68 and column 7, lines 1-5 where the wheel speed of an aircraft is

passed through a first differentiator to determine the deceleration of an aircraft, i.e. the first derivative of the wheel speed, which is then passed through a second differentiator to determine the rate of change of deceleration, i.e. the second derivative of the wheel speed. Both differentiators are high pass filters. Although Crapanzano teaches where only the derivative of the deceleration is determined, the high pass filtering is equally applicable to determine the derivative of the acceleration or the force).

It would be obvious to one skilled in the art to use the high pass filter as taught in Hayakawa to differentiate the equilibrium relationship with respect to time because a high pass filter may be used to determine the derivative of a value and determining the derivative of a value is well known in the art as taught in Crapanzano (see Crapanzano column 6, lines 62-68 and column 7, lines 1-5).

Regarding claim 25, Hayakawa, as modified by Crapanzano in claim 24, teaches where the vehicle includes a commercial vehicle (see Hayakawa column 1, lines 18-33).

Claim Rejections - 35 USC § 103

Claims 18-20, 26, 27, 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hayakawa et al. (US 6347269 B1) in view of Crapanzano et al. (US 4773013) and further in view of Zhu et al. (US 6167357).

Regarding claim 18, Hayakawa, as modified by Crapanzano in claim 13, does not explicitly teach where the measured quantities are available in a control unit of the vehicle.

Zhu teaches where the measured quantities are available in a control unit of the vehicle (see Zhu figure 1, control system 10, vehicle speed sensor 24, accelerometer 46, accelerator pedal 26, fuel system 30 and control computer 12. See also column 8, lines 21-33).

It would be obvious to one skilled in the art for the measured quantities taught in Hayakawa to be available in a control unit of the vehicle as taught in Zhu because an engine control system typically includes sensors and logic for determining driving force and acceleration.

Regarding claim 19, Hayakawa, as modified by Crapanzano in claim 13 and further modified by Zhu in claim 18, does not teach where the method further comprises filtering the measured quantities as a function of a signal quality.

Zhu further teaches where the measured quantities of acceleration and drive force are filtered as a function of signal quality (see Zhu figure 2, stage 110. See also Zhu column 10, lines 65-67 and column 11, lines 1-17).

It would be obvious to one skilled in the art to add the step of filtering the measured values of acceleration and drive force as taught in Zhu to the method of calculating vehicle mass taught in Hayakawa because filtering measured quantities as a function of the signal quality ensures that the data is capable of being reliably used to estimate vehicle mass (see Zhu column 11, lines 11-17).

Regarding claim 20, Hayakawa, as modified by Crapanzano in claim 13, does not teach where the method further comprises: repeatedly measuring the measured quantities; and weighting the measurements differently.

Zhu teaches where a method for estimating vehicle weight includes a step for repeatedly measuring the measured quantities and weighing the measurements differently (see Zhu method 100 showing repeated measurement of the data points in step 104. See also Zhu column 10, lines 46 through 67; column 11, lines 1-17; column 11, lines 18-38).

It would be obvious to one skilled in the art to add the step of repeatedly measuring the acceleration and drive force and weighing the measurements differently as taught in Zhu to the method of calculating vehicle mass taught in Hayakawa because this ensures that the data is capable of being reliably used to estimate vehicle mass (see Zhu column 11, lines 11-17).

Regarding claim 26, Hayakawa, as modified by Crapanzano in claim 24, does not explicitly teach the calculation unit is integrated into a control unit of the vehicle.

Zhu teaches where a mass calculation unit is integrated into a control unit of a vehicle (see Zhu figure 1, control system 10, vehicle speed sensor 24, accelerometer 46, accelerator pedal 26, fuel system 30 and control computer 12. See also column 8, lines 21-33 and column 3, lines 58-62).

It would be obvious to one skilled in the art to integrate the vehicle mass calculation unit in Hayakawa into a control unit of a vehicle as taught in Zhu because an engine control system typically includes sensors and logic for determining driving force and acceleration. A mass calculation unit that is separate from the control unit would add cost and complexity to the vehicle with no added utility.

Regarding claim 27, Hayakawa, as modified by Crapanzano in claim 24, teaches where, from measured quantities, the motive force and the one of (a) the acceleration and (b) the deceleration are determined (see Hayakawa figure 6, acceleration sensor 30, throttle valve sensor 12, engine rotation speed sensor 14, shift sensor 18, vehicle speed sensor 20. See also Hayakawa column 7, lines 18-58), the measured quantities are repeatedly measured (see Hayakawa column 7, lines 48-54), the drive resistances include a sum of one of (a) an accelerative force and (b) a deceleration force as a function of the mass and one of (a) an uphill force and (b) a downhill force as a function of the gradient angle (see Hayakawa column 7, lines 38-51 and column 4, lines 31-41), wherein the mass is calculated from the equation of $m = (dF / dt) / (da / dt)$ wherein a represents a time derivation of a longitudinal vehicle velocity and F represents the motive force of the vehicle (see Hayakawa column 6, lines 26-41 where the mass can be determined from equation (5) "$\underline{\alpha}(k) = \underline{F}(k)/(\theta m) + e(k)$" where $\underline{\alpha}$ is the acceleration deducted by a signal of lower frequency, $\underline{F}$ is the driving force deducted by a lower frequency, k is a sampling time interval, θm is the vehicle mass, and e is the residual error due to the gradient. In instances where e(k) is negligible, it can be ignored and rearranging equation 5 will result in $\theta m = \underline{F}(k)/ \underline{\alpha}(k)$. See the rejection of claim 24 above regarding determining the derivative using a high pass filter).

However, Hayakawa, as modified by Crapanzano in claim 24 does not teach where the measured quantities are repeatedly measured <u>and</u> the measurements are weighted differently; the measured quantities are filtered as a function of a signal quality; and where the measured quantities are available in a control unit of the vehicle.

Zhu teaches where a method for estimating vehicle weight includes a step for repeatedly measuring the measured quantities and weighing the measurements differently (see Zhu method 100 showing repeated measurement of the data points in step 104. See also Zhu column 10, lines 46 through 67; column 11, lines 1-17; column 11, lines 18-38); filtering the measured quantities as a function of a signal quality (see Zhu figure 2, stage 110. See also Zhu column 10, lines 65-67 and column 11, lines 1-17); and where the measured quantities are available in a control unit of the vehicle (see Zhu figure 1, control system 10, vehicle speed sensor 24, accelerometer 46, accelerator pedal 26, fuel system 30 and control computer 12. See also column 8, lines 21-33).

It would be obvious to one skilled in the art to add the step of repeatedly measuring the acceleration and drive force and weighing the measurements differently as taught in Zhu to the method implemented by the device for calculating vehicle mass taught in Hayakawa because this ensures that the data is capable of being reliably used to estimate vehicle mass (see Zhu column 11, lines 11-17). It would further be obvious to one skilled in the art to add the step of filtering the measured values of acceleration and drive force as taught in Zhu because filtering measured quantities as a function of the signal quality ensures that the data is capable of being reliably used to estimate the vehicle mass (see Zhu column 11, lines 11-17). It would further still be obvious to one skilled in the art for the measured quantities taught by Hayakawa to be available in a control unit of the vehicle as taught in Zhu because an engine control system typically includes sensors and logic for determining driving force and acceleration.

Regarding claim 29, Hayakawa, as modified by Crapanzano in claim 13, teaches where the method further comprises: determining, from measured quantities, the motive force and the one of (a) the acceleration and (b) the deceleration (see Hayakawa figure 6, acceleration sensor 30, throttle valve sensor 12, engine rotation speed sensor 14, shift sensor 18, vehicle speed sensor 20. See also Hayakawa column 7, lines 18-58); repeatedly measuring the measured quantities (see Hayakawa column 7, lines 48-54) wherein the drive resistances include a sum of one of (a) an accelerative force and (b) a deceleration force as a function of the mass and one of (a) an uphill force and (b) a downhill force as a function of the gradient angle (see Hayakawa column 7, lines 44-51 and column 4, lines 31-41), wherein the mass is calculated from the equation of $m = (dF / dt) / (da / dt)$ wherein a represents a time derivation of a longitudinal vehicle velocity and F represents the motive force of the vehicle (see Hayakawa column 6, lines 26-41 where the mass can be determined from equation (5) "$\underline{\alpha}(k) = \underline{F}(k)/(\theta m) + e(k)$" where $\underline{\alpha}$ is the acceleration deducted by a signal of lower frequency, $\underline{F}$ is the driving force deducted by a lower frequency, k is a sampling time interval, θm is the vehicle mass, and e is the residual error due to the gradient. In instances where e(k) is negligible, it can be ignored and rearranging equation 5 will result in $\theta m = \underline{F}(k)/ \underline{\alpha}(k)$. See the rejection of claim 13 above regarding determining the derivative using a high pass filter).

However, Hayakawa, as modified by Crapanzano in claim 13, does not teach repeatedly measuring the measured quantities <u>and</u> weighting the measurements differently; filtering the measured quantities as a function of a signal quality; and wherein the measured quantities are available in a control unit of the vehicle.

Zhu teaches where a method for estimating vehicle weight includes a step for repeatedly measuring the measured quantities and weighing the measurements differently (see Zhu method 100 showing repeated measurement of the data points in step 104. See also Zhu column 10, lines 46 through 67; column 11, lines 1-17; column 11, lines 18-38); filtering the measured quantities as a function of a signal quality (see Zhu figure 2, stage 110. See also Zhu column 10, lines 65-67 and column 11, lines 1-17); and where the measured quantities are available in a control unit of the vehicle (see Zhu figure 1, control system 10, vehicle speed sensor 24, accelerometer 46, accelerator pedal 26, fuel system 30 and control computer 12. See also column 8, lines 21-33).

It would be obvious to one skilled in the art to add the step of repeatedly measuring the acceleration and drive force and weighing the measurements differently as taught in Zhu to the method of calculating vehicle mass taught in Hayakawa because this ensures that the data is capable of being reliably used to estimate vehicle mass (see Zhu column 11, lines 11-17). It would further be obvious to one skilled in the art to add the step of filtering the measured values of acceleration and drive force as taught in Zhu because filtering measured quantities as a function of the signal quality ensures that the data is capable of being reliably used to estimate the vehicle mass (see Zhu column 11, lines 11-17). It would further still be obvious to one skilled in the art for the measured quantities taught by Hayakawa to be available in a control unit of the vehicle as taught in Zhu because an engine control system typically includes sensors and logic for determining driving force and acceleration.

Claim Rejections - 35 USC § 103

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hayakawa et al. (US 6347269 B1) in view of Crapanzano et al. (US 4773013) and further in view of Mori (US 6745112 B2), Randal et. al (V. T. Randal, J. L. Schmalzel, and A. P. Shepard, “Floating-Point Computation Using a Microcontroller,” Proceedings of the Annual International Conference of the IEEE, 1988, pp 1243-1244, vol. 3), Predko (M. Predko, *Programming and Customizing the PIC Microcontroller*. New York, NY: McGraw-Hill, 1998), and Bellinger et al. (US 6567734 B2).

Regarding claim 23, Hayakawa, as modified by Crapanzano in claim 13, teaches where the method further comprises calculating the mass (see the rejection of claim 13).

However, Hayakawa does not teach where the method further comprises calculating the reciprocal of the mass or forming a weighted average value.

Mori teaches where mass is used in the calculation of vehicle parameters, specifically where mass is used as a divisor (see Mori figures 4 and 9A where a vehicle a vehicle side slip angle is estimated in part by calculating a vehicle side slip angle differential using equation 6 which uses mass as a divisor).

Randal and Predko teach where using a reciprocal of a value as a multiplier can be more efficient than using the value itself as a divisor (see Randal page 2, column 1 where an 8051 microprocessor running floating point routines required 450 cycles to run a typical multiplication operation and 1070 cycles to run a typical division operation.

See also Predko pages 302-304 for pseudo-code representing multiplication and division in a microcontroller where multiplication requires fewer steps than division. It is well known in the art that division in a microprocessor typically requires more computational resources than multiplication. Therefore, in situations where a value is repeatedly used as a divisor, it is more efficient to determine the reciprocal and use it as a multiplier).

It would be obvious to one skilled in the art to calculate the reciprocal value of the mass in Hayakawa because reducing computational load when determining a vehicle dynamic which require mass as a variable, such as the side slip angle, is desirable (see Mori column 1, lines 59-64 where conventional side slip angle estimation methods are problematic due to the increase in the computational load) and calculating the inverse of the mass and using it as a multiplier in algorithms which call for it to be used repeatedly as a divisor would reduce the computational load (see Mori figure 4, equation 6. Solving equation 6 using mass would require three division operations whereas solving equation 6 using the reciprocal of mass would require one division operation to find the reciprocal of the mass and 3 multiplication operations. The latter method would be more efficient, as shown by Randal and Predko).

Bellinger teaches a method for estimating a vehicle mass where the method further comprises forming a weighted average value (see Bellinger column 22, lines 49-67 and column 23, lines 1-26 where a vehicle mass estimate is computed as a weighted average of the samples contained in a register holding a predefined number of instantaneous vehicle mass samples).

It would be obvious to one skilled in the art to add a step forming a weighted average value of the estimated mass as taught in Bellinger to the method of determining vehicle mass taught in Hayakawa because weighted averaging is well known in the art (see Bellinger column 22, lines 21-25 where it is explained that those skilled in the art will recognize other known techniques for computing the estimated vehicle mass as an average, weighted or otherwise, of at least some of the instantaneous vehicle mass samples).

Claim Rejections - 35 USC § 103

Claims 28, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hayakawa et al. (US 6347269 B1) in view of Crapanzano et al. (US 4773013) and further in view of Mori (US 6745112 B2), Randal et. al (V. T. Randal, J. L. Schmalzel, and A. P. Shepard, "Floating-Point Computation Using a Microcontroller," Proceedings of the Annual International Conference of the IEEE, 1988, pp 1243-1244, vol. 3) and Predko (M. Predko, *Programming and Customizing the PIC Microcontroller*. New York, NY: McGraw-Hill, 1998).

Regarding claim 28, Hayakawa, as modified by Crapanzano in claim 24, teaches where the computer-aided differentiating is performed continuously and recursively (see Hayakawa column 6, lines 26-60), wherein the computer-aided differentiating is performed one of (a) according to a two-point differentiation and (b) with a state-variable filter (see the rejection of claim 24 above regarding differentiation)

However, Hayakawa, as modified by Crapanzano in claim 24 does not teach where the calculating includes calculating the mass and a reciprocal value of the mass.

Mori teaches where mass is used in the calculation of vehicle parameters, specifically where mass is used as a divisor (see Mori figures 4 and 9A where a vehicle a vehicle side slip angle is estimated in part by calculating a vehicle side slip angle differential using equation 6 which uses mass as a divisor).

Randal and Predko teach where using a reciprocal of a value as a multiplier can be more efficient than using the value itself as a divisor (see Randal page 2, column 1 where an 8051 microprocessor running floating point routines required 450 cycles to run a typical multiplication operation and 1070 cycles to run a typical division operation. See also Predko pages 302-304 for pseudo-code representing multiplication and division in a microcontroller where multiplication requires fewer steps than division. It is well known in the art that division in a microprocessor typically requires more computational resources than multiplication. Therefore, in situations where a value is repeatedly used as a divisor, it is more efficient to determine the reciprocal and use it as a multiplier).

It would be obvious to one skilled in the art to calculate the reciprocal value of the mass in Hayakawa, as modified by Crapanzano in claim 24, because reducing computational load when determining a vehicle dynamic which require mass as a variable, such as the side slip angle, is desirable (see Mori column 1, lines 59-64 where conventional side slip angle estimation methods are problematic due to the increase in the computational load) and calculating the inverse of the mass and using it as a

multiplier in algorithms which call for it to be used repeatedly as a divisor would reduce the computational load (see Mori figure 4, equation 6. Solving equation 6 using mass would require three division operations whereas solving equation 6 using the reciprocal of mass would require one division operation to find the reciprocal of the mass and 3 multiplication operations. The latter method would be more efficient, as shown by Randal and Predko).

Regarding claim 30, Hayakawa, as modified by Crapanzano in claim 13, teaches where the computer-aided differentiating is performed continuously and recursively (see Hayakawa column 6, lines 26-60), wherein the computer-aided differentiating is performed one of (a) according to a two-point differentiation and (b) with a state-variable filter (see the rejection of claim 13 above regarding differentiation).

However, Hayakawa, as modified by Crapanzano in claim 13, does not teach where the calculating includes calculating the mass and a reciprocal value of the mass.

Mori teaches where mass is used in the calculation of vehicle parameters, specifically where mass is used as a divisor (see Mori figures 4 and 9A where a vehicle a vehicle side slip angle is estimated in part by calculating a vehicle side slip angle differential using equation 6 which uses mass as a divisor).

Randal and Predko teach where using a reciprocal of a value as a multiplier can be more efficient than using the value itself as a divisor (see Randal page 2, column 1 where an 8051 microprocessor running floating point routines required 450 cycles to run a typical multiplication operation and 1070 cycles to run a typical division operation. See also Predko pages 302-304 for pseudo-code representing multiplication and

division in a microcontroller where multiplication requires fewer steps than division. It is well known in the art that division in a microprocessor typically requires more computational resources than multiplication. Therefore, in situations where a value is repeatedly used as a divisor, it is more efficient to determine the reciprocal and use it as a multiplier).

It would be obvious to one skilled in the art to calculate the reciprocal value of the mass in Hayakawa because reducing computational load when determining a vehicle dynamic which require mass as a variable, such as the side slip angle, is desirable (see Mori column 1, lines 59-64 where conventional side slip angle estimation methods are problematic due to the increase in the computational load) and calculating the inverse of the mass and using it as a multiplier in algorithms which call for it to be used repeatedly as a divisor would reduce the computational load (see Mori figure 4, equation 6. Solving equation 6 using mass would require three division operations whereas solving equation 6 using the reciprocal of mass would require one division operation to find the reciprocal of the mass and 3 multiplication operations. The latter method would be more efficient, as shown by Randal and Predko).

(10) Response to Argument

I. Claims 13-17, 21, 22, 24 and 25 on appeal are properly rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6347269 to Hayakawa et al. in view of U.S. Patent No. 4773013 to Crapanzano et al.

Applicant alleges that the applied references do not disclose nor suggest the feature of an assumption of a constant gradient angle (of the roadway) when estimating

the vehicle mass as a function of time. In support of this position, Applicant cites page 3, lines 15-31 of the Applicant's present specification which discloses that *when a vehicle is traveling along any route, gradient angle α of the roadway is a function of time t and if one assumes the change in gradient angle α(t) is very small in time interval dt considered, the influence of gradient angle α(t) may be assumed to be constant for a time, so that gradient angle α may not have to be estimated, calculated or measured by a cost-creating sensor*. Applicant further references the final office action (pages 2 and 3) and the relevant portions of Hayakawa (column 5, lines 36-45 and column 5, line 46 thru column 6, line 12) cited therein, as showing that Hayakawa assumes a small gradient which, according to Applicant, is not the same as the assumption of a constant gradient.

Examiner respectfully disagrees. As disclosed on page 3, lines 15-31 of Applicant's present specification, if one assumes the change in the gradient angle of the roadway is *very small during the time interval considered*, the influence of the gradient angle *may be assumed to be constant for a time*. Therefore, an assumption of a constant gradient, as defined by Applicant, is actually an assumption of a very small gradient variation. This is equivalent to the assumption made in Hayakawa in column 5, lines 36-45 where laws relative to road structures define maximum gradient variations and a small gradient variation may be assumed. See also Hayakawa figures 1-2 and column 5, lines 46-55 regarding the specification of a part of a road with a varying gradient pursuant to the law. Particularly, see the row in figure 1 entitled 'GRADIENT VARIATION RATE [%/sec]' which shows that the allowable percentage change in the

gradient is small (e.g. 2.5%/sec for a road with a design speed of 40 km/h and a required vertical sectional curve length of 4.4 m/%). The result of this, as shown in Hayakawa column 5, line 46 thru column 6, line 12 and figure 3, is that a function Θ(t) indicative of a change in the gradient has frequency components that are less than 2 Hz, whereas the variation of the driving force contains frequency components of 2 Hz or higher. Therefore, as further explained in Hayakawa column 6, lines 1-4 and 18-25, because of the assumption of a small change in the gradient, i.e. less than 2 Hz, a high pass filter with a 2 Hz cutoff frequency may be used to remove the influence of the gradient on the acceleration and driving force and the vehicle mass may be calculated using the high-pass filtered acceleration and driving force.

Applicant, in pages 8-9 of the brief, further alleges that the high-pass filter in Hayakawa "measures" the variation in the gradient angle to determine if it is significant enough to include in the vehicle mass calculation. Examiner respectfully disagrees. As taught in Hayakawa column 5, line 46 thru column 6, line 25, the high-pass filter does not "measure" the variation in the gradient, rather it eliminates the effect of the small change in the gradient on the acceleration and driving force signals by removing the components of these signals caused by the small, i.e. less than 2 Hz, assumed variation in the gradient. This is equivalent to the differentiation performed by Applicant to remove the influence of the gradient angle because of the assumption of a small change in the gradient, as described on page 3, lines 13-31 and page 5, line 17-20 of the Applicant's present specification.

Applicant, in page 9 of the brief, further alleges that Hayakawa does not teach an equilibrium relationship. Applicant first points out the text in Hayakawa column 5, lines 5-15 containing expression 4 and alleges that this expression is not an equilibrium relationship because of the presence of $\underline{\Theta}$ which represents the change in the gradient. Examiner respectfully disagrees. The same passage in Hayakawa teaches that –g sin Θ is due to the gradient resistance failed to be removed *<u>or a measurement error of the acceleration or gross driving force F</u>*. This is not the same as alleging that $\underline{\Theta}$ represents the change in the gradient. Applicant, in page 9 of the brief, further alleges that the Examiner has relied on inherency regarding the argument presented on pages 3 and 4 of the final office action which states that "If a cutoff frequency greater than the frequency of the gradient variations is selected, such as 2 Hz, $\underline{\Theta}$ is eliminated or minimized". Applicant cites M.P.E.P. §2112 and Ex parte Levy, 17 U.S.P.Q.2d 1461, 1464 as requiring the Office to provide "basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristics necessarily flows from the teaching of the applied art." In response to this, Examiner would like to point out column 6, lines 23-25 of Hayakawa which teaches that the cut-off frequency is not limited to 2 Hz and can be appropriately determined based on results of experimental trials. In addition, an analysis of figure 3 and column 5, line 57 thru column 6, line 1 of Hayakawa, shows that Θ(t) has a frequency distribution that extends slightly past 2 Hz. Therefore moving the cut-off frequency past 2 Hz would minimize the residual error due to gradient variation.

Applicant, in pages 9-10 of the brief, further alleges that equation 5 in Hayakawa does not teach assumption of a constant gradient and an equilibrium relationship because of the presence of the residual error e(k). Examiner respectfully disagrees. Hayakawa, as disclosed in column 5, line 46 thru column 6, line 25, relies on an assumption of a small gradient in designing the cutoff frequency for the high pass filter which provides the filtered values of acceleration and driving force used in equation 4. As explained further in Hayakawa column 5, lines 5-15 and column 6, lines 26-41, the term -g sin Θ in equation 4 may be due to gradient resistance failed to be removed by the high pass filter *or an error of an acceleration α or a gross driving force F*. The term -g sin Θ may be assumed to be a residual error e(k), equation 4 may be rewritten as equation 5 and the residual error e(k) *may be neglected* or removed using least square method if it is not negligible. Based on this, it is clear that Hayakawa anticipates situations where: (1) the filter may fail to entirely remove the gradient resistance and/or errors may be present in the measurement of the acceleration or gross driving force and, in either case, e(k) cannot be neglected; or (2) the filter is assumed to entirely, or almost entirely, remove the gradient resistance and the errors in the measurement of the acceleration and gross driving force are assumed to be negligible, in which case e(k) can be neglected. If the method in Hayakawa is implemented with situation (2) in mind, the result is an equilibrium relationship between mass, and the filtered values of acceleration and driving force. Applicant alleges that ignoring e(k) does not necessarily correspond to an equation without e(k) as a variable. However, the end result of ignoring e(k) is that equation 5 is solved without e(k), as explained in Hayakawa column

6, lines 26-41 where the mass can be obtained *instantly* when e(k) is neglected. Therefore, the Examiner does not need to make a conclusory statement that it would be obvious to solve the equation for instances where the variation in road gradient is negligible because Hayakawa clearly teaches just that.

Applicant alleges, in page 10 of the brief, that the Examiner conclusorily asserted in the Advisory Action of August 20, 2009 that the assumption of a constant gradient corresponds to the assumption of a small change in the gradient as in the Hayakawa reference. This assertion is not conclusory, rather it is based on the teaching of Hayakawa regarding assumption of a small gradient, as explained above, and page 3, lines 15-31 of Applicant's present specification which defines the assumption of a constant gradient as an assumption of a very small gradient.

II. Claims 18-20, 26, 27 and 29 on appeal are properly rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6347269 to Hayakawa et al. in view of U.S. Patent No. 4773013 to Crapanzano et al. and further in view of U.S. Patent No. 61647357 to Zhu et al.

Regarding claims 18-20, 26, 27 and 29, Applicant asserts in page 11 of the brief that the claims are allowable for the same reasons claims 13 and 24 are allowable since Zhu does not cure – and is not asserted to cure – the deficiencies of the Hayakawa reference.

However, claims 13 and 24 are properly rejected, as shown above, and therefore, without further argument regarding the patentability of claims 18-20, 26, 27 and 29, these claims too are properly rejected.

III. Claim 23 on appeal is properly rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6347269 to Hayakawa et al. in view of U.S. Patent No. 4773013 to Crapanzano et al. and further in view of U.S. Patent No. 61647357 to Mori, "Floating-Point Computation Using a Microcontroller" by Randel et al, "Programming and Customizing the PIC Microcontroller" by Predko and U.S. Patent No. 6567734 to Bellinger et al.

Applicant alleges, in page 11 of the brief, that Hayakawa does not involve calculations where mass is repeatedly used as a divisor and therefore it would not have been obvious to use the technique taught in the combination of Mori, Randal and Predko to reduce the computational load by calculating the reciprocal value of the mass when the mass is repeatedly used as a divisor.

Examiner respectfully disagrees. Hayakawa, as disclosed in column 1, lines 6-9, is concerned with providing a vehicle mass estimate for use in a vehicle system, such as an automatic transmission. Mori, as disclosed in figures 1, 4 and column 7, lines 20-27, teaches where vehicle mass is used in another vehicle system, in this case a sideslip angle estimating apparatus. In the sideslip angle estimating apparatus in Mori, vehicle mass is used as a divisor several times as evidenced by equation 6 in figure 4. Randal and Predko each teach where division in a microcontroller requires more computing power than multiplication. Taken together, Mori, Randal and Predko teach that in certain situations it is more efficient to provide the reciprocal of the vehicle mass to a vehicle system. Therefore, it would be obvious to one of ordinary skill in the art for an apparatus that calculates the vehicle mass and provides it to a vehicle system, such

as the one in Hayakawa, to also calculate the reciprocal value of the vehicle mass and provide it to vehicle systems that employ algorithms requiring vehicle mass as a divisor because this would decrease the computational load of the vehicle control system.

IV. Claims 28 and 30 on appeal are properly rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6347269 to Hayakawa et al. in view of U.S. Patent No. 4773013 to Crapanzano et al. and further in view of U.S. Patent No. 61647357 to Mori, "Floating-Point Computation Using a Microcontroller" by Randel et al. and "Programming and Customizing the PIC Microcontroller" by Predko.

Regarding claims 28 and 30, Applicant asserts in page 12 of the brief that the claims are allowable for the same reasons claim 13 is allowable since the secondary references do not cure – and are not asserted to cure – the deficiencies of the Hayakawa reference.

However, claim 13 is properly rejected, as shown above, and therefore, without further argument regarding the patentability of claims 28 and 30, these claims too are properly rejected.

V. Response to summary arguments

Applicant, in pages 12-15 of the brief, puts forth summary arguments regarding the adequacy of Examiner's obviousness rejections. Since these arguments are not directed to any particular aspect of the rejection and Examiner has provided adequate replies to the specific arguments previously presented in the brief, the summary arguments are not addressed in this answer.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Peter D Nolan/

Examiner, Art Unit 3661

/Thomas G. Black/

Supervisory Patent Examiner, Art Unit 3661

Conferees:

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Tuan C. To /TT/